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The abundance and reproductive autonomy of humpback whales from the New Caledonia (South Pacific) wintering grounds were investigated using capture-recapture models and paternity inference based on nuclear microsatellite genotyping, mitochondrial DNA sequencing, molecular sex identification and photographs of natural markings (photo-identification). The analyses included records of 213 individuals (excluding 16 calves used in paternity inference) identified by genotypes (9 loci), and 210 identified by fluke photographs, collected from 1995 to 2001. By comparing records of 175 individuals identified using both genotypes and photographs, a small number of errors were detected (and corrected) in the photo-identification catalogue and in the field and laboratory notes of the genotypes. Using the weighted mean of the Petersen capture-recapture model, the estimate of abundance based on genotyping ($N = 533$, $CV = 0.15$) was larger than the estimate based on photo-identification ($N = 327$, $CV = 0.11$). Sex-specific estimates of abundance based on genotypes were similar for males and females although the variance of the female estimate was greater than the male ($N_f = 248$, $CV = 0.30$; $N_m = 288$, $CV = 0.18$, respectively). The paternity of 5 calves from 16 sampled cow/calf pairs was inferred from the total sample of 133 non-calf males (one offspring each). The 16 sampled cow/calf pairs and the 5 inferred paternities were used for an alternate 'gametic recapture' estimate of male abundance. This gametic recapture estimate ($N_m = 379$, $CV = 0.30$) was similar to the sex-specific estimate based on the organismal recapture using a 2-sample model ($N_m = 382$, $CV = 0.22$). The close agreement of the organismal and gametic recapture estimates support the assumption that this humpback whale wintering ground represents an autonomous population unit that is relatively closed to demographic and reproductive interchange. The current low abundance of the New Caledonian breeding unit highlights the slow recovery of this and some other regional populations in the Southern Hemisphere following intensive 20th century commercial and illegal whaling.